TETRA TECH

December 22, 2016

Mr. Tom Mahler
On-Scene Coordinator
U.S. Environmental Protection Agency, Region 7
11201 Renner Boulevard
Lenexa, Kansas 66219

Subject: **Quality Assurance Project Plan, Revision 01**
Pre-CERCLIS Screening at Bridgeton Dust Site
Bridgeton, Missouri
U.S. EPA Region 7 START 4, Contract No. EP-S7-13-06, Task Order No. 0104.003
Task Monitor: Tom Mahler, On-Scene Coordinator

Dear Mr. Mahler:

Tetra Tech, Inc. is submitting the attached revised Quality Assurance Project Plan for a Pre-CERCLIS Screening of residential properties in the Spanish Village subdivision in Bridgeton, Missouri. If you have any questions or comments, please contact the Project Manager, at (816) 412-1775.

Sincerely,

Robert Monnig, PE
START Project Manager

for Ted Faile, PG, CHMM
START Program Manager

Enclosures

cc: Debra Dorsey, Region 7 START Project Officer (cover letter only)

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QUALITY ASSURANCE PROJECT PLAN
FOR PRE-CERCLIS SCREENING AT
BRIDGETON DUST SITE
BRIDGETON, MISSOURI

Superfund Technical Assessment and Response Team (START) 4
Contract No. EP-S7-13-06, Task Order No. 0104.003

Prepared For:

U.S. Environmental Protection Agency
Region 7
11201 Renner Boulevard
Lenexa, Kansas 66219

December 22, 2016
Revision 01

Prepared By:

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APPROVED BY:

Robert Monnig, PE, START Project Manager	12-22-16 Date
Ted Faile, PG, CHMM, START Program Manager	12-22-16 Date
Kathleen Homer Digitally signed by Kathleen Homer DN: cn=Kathleen Homer, o=Tetra Tech, Inc. EMI Division, ou=EMI, email=kathy.homer@tetratech.com, c=US Date: 2016.12.22 13:42:02 -06'00' Kathleen Homer, START Quality Assurance Manager	Date
Tom Mahler, EPA On-Scene Coordinator, Superfund Division	Date
Diane Harris, EPA Quality Assurance Manager	Date

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1.0 PROJECT MANAGEMENT

1.1 DISTRIBUTION LIST

Region 7 EPA	Tom Mahler, On-Scene Coordinator Diane Harris, Quality Assurance Manager
Region 7 START	Rob Monnig, Project Manager Ted Faile, Program Manager Kathleen Homer, Quality Assurance Manager

1.2 PROJECT, TASK ORGANIZATION, AND SCOPE OF WORK

The Tetra Tech, Inc. (Tetra Tech) Superfund Technical Assessment and Response Team (START) has been tasked by the U.S. Environmental Protection Agency (EPA) to assist with a Pre-CERCLIS Screening at residential properties in the Spanish Village subdivision in Bridgeton, Missouri. The site of this screening will be known as the Bridgeton Dust site. Rob Monnig of Tetra Tech will serve as the START Project Manager. He will be responsible for ensuring that sampling of environmental media proceeds as described in this Quality Assurance Project Plan (QAPP), and for providing periodic updates to the client concerning the status of the project, as needed. Tom Mahler will be the EPA On-Scene Coordinator for this activity. The Tetra Tech START quality assurance (QA) manager and the Tetra Tech Program Manager will provide technical assistance, as needed, to ensure that necessary QA issues are adequately addressed.

This investigation will include both indoor and outdoor sampling activities. The indoor activities will include real-time surveys of interior building surfaces for alpha, beta, and gamma radiation, collection of wipe dust samples for on-site analyses for gross alpha/beta followed by laboratory analysis for radionuclides, and collection of bulk dust samples for laboratory radionuclide analysis. Outdoor sampling activities will include a real-time gamma survey of surface soils and collection of soil samples for laboratory analysis for radionuclides.

START will adhere to this QAPP as much as possible, but may alter proposed activities in the field if warranted by site-specific conditions and unforeseen hindrances that prevent implementation of any aspect of this QAPP in a feasible manner. Such deviations will be recorded in the site logbook, as necessary. This QAPP will be available to the field team at all times during sampling activities to serve as a key reference to proposed activities described herein.

1.3 PROBLEM DEFINITION, BACKGROUND, AND SITE DESCRIPTION

This QAPP was prepared by Tetra Tech START to investigate concerns regarding concentrations of radionuclides above naturally-occurring levels reported inside a residence in the Spanish Village subdivision in Bridgeton, Missouri. EPA has been unable to verify the quality of the reported data or what sampling methods were used. The allegation of contamination inside a residence has been made public creating additional concerns for nearby residents. EPA is conducting this Pre-CERCLIS screening at up to three residences to determine if elevated levels of radionuclides are present beyond what is naturally occurring and if further investigation or response under CERCLA may be warranted. Pending access being granted by the property owners, EPA will conduct the screening at the residence with alleged contamination and at up to two additional residences located as close as possible to the residence with alleged contamination.

1.4 PROJECT AND TASK DESCRIPTION

Activities described in this QAPP will address the following:

- Collection of real-time gamma measurements of soils on residential properties
- Collection of surface and subsurface soil samples for laboratory analysis for radionuclides
- Collection of real-time alpha, beta, and gamma measurements of indoor building surfaces
- Collection of real-time gamma exposure measurements on the interior of residential properties
- Collection of real-time indoor radon measurements
- Collection of wipe samples inside residences to be counted on-site for gross alpha and gross beta activity, and for laboratory analysis for specific radionuclides
- Collection of bulk dust samples via vacuum cartridge for laboratory analysis for specific radionuclides
- Determination if further investigation or additional actions under CERCLA are warranted via evaluation of data from the investigation, including comparison of concentrations of radionuclides in residential soils to background levels and comparison of wipe sampling results to applicable health-based standards
- Documentation of pre-CERCLIS investigation activities.

The following is the anticipated schedule of activities for the pre-CERCLIS screening:

- December 26 to 30, 2016 – Conduct field survey and sampling activities

- January 6, 2017 – Provide preliminary screening results and on-site measurement data to the property owners
- Week of March 3, 2017 – Submit final report documenting Pre-CERCLIS screening activities (including real-time survey results, on-site measurements, and sampling methods with laboratory analytical results).

Relevant aspects of the project are described in the following sections of this QAPP.

1.5 QUALITY OBJECTIVES AND CRITERIA FOR ACQUIRED DATA

The quality assurance (QA) objective for this project is to provide valid data of known and documented quality. Specific data quality objectives are discussed in terms of accuracy, precision, completeness, representativeness, and comparability.

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. For radiological analyses by the laboratory, accuracy will be expressed as "total uncertainty" value, which will be calculated and reported per the analytical method. The analytical component of accuracy will be expressed as percent recovery, based on analyses of laboratory-prepared spike samples and performance evaluation audit samples.

Precision for this project is defined as a measure of agreement among individual measurements of laboratory-prepared duplicate samples. Data completeness will be expressed as the percentage of data generated that are considered valid. A completeness goal of 100 percent will be applied to this project; however, if that goal is not met, site decisions may still be made based on the remaining data. No individual sample has been identified as a critical sample.

Representativeness of collected samples is facilitated by establishing and following criteria and procedures identified in this QAPP. Data comparability is achieved by requiring that all data generated for the project be reported in common units. Table 1 lists the various types of data that will be generated and specific reporting units.

TABLE 1

SPECIFIC DATA REPORTING UNITS

Parameter	Unit
Radionuclides in soil and dust	picoCuries per gram (pCi/g)
Radionuclides on surfaces	picoCuries per square centimeter (pCi/cm^2)
Gross surface activity	Disintegrations per minute per square centimeter (dpm/cm^2)
Gross gamma activity	Counts per minute (cpm)
Gamma exposure rate	MicroRoentgens per hour (μR/hr)
Radon concentration	picoCuries per liter (pCi/L)
Time	Military time (00:01 - 24:00)

1.6 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATION

All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response) training course and annual refreshers. Familiarization with radiation screening instrumentation and procedures will be necessary for the Tetra Tech START team.

1.7 DOCUMENTATION AND RECORDS

Tetra Tech START personnel will maintain a field logbook or field sheets to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken by Tetra Tech START also will be recorded in the field logbook or field sheets. Information pertaining to all samples collected for laboratory analysis during this event (such as sampling dates and times, locations, and so on) will be recorded in the field logbook or field sheets. Labels generated by START will be affixed to the sample containers, identifying sample numbers, dates collected, and requested analyses. Chain-of-custody (COC) records will be completed and maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis. A laboratory narrative (included as part of the laboratory's analytical report) and a field narrative prepared by START will be included in the final project report (see Section 3.2). The project records and report will be maintained in accordance with START contract EP-S7-13-06.

A health and safety plan (HASP) prepared by Tetra Tech START prior to field activities will address site-specific hazards. The HASP will be reviewed and signed by all field personnel prior to field work, indicating that they understand the plan and its requirements. Copies of the plan will be available to all personnel throughout sampling activities.

2.0 MEASUREMENT AND DATA ACQUISITION

The following sections address aspects of sampling and analysis.

2.1 SAMPLING PROCESS DESIGN

Under this task order, START will conduct real-time monitoring and sampling to investigate the presence of radionuclides in soils and interior dust. The proposed sampling scheme for this project is judgmental (based on the best professional judgment of the sampling team), in accordance with the *Removal Program Representative Sampling Guidance*, Volume 1: Soil, Office of Solid Waste and Emergency Response (OSWER) Directive 9360.4-10, November 1991. Soil and select dust samples collected during the survey will be submitted for laboratory radionuclide analysis. Field procedures will follow standard operating procedures (SOP) outlined in the QAPP. Sampling strategy and procedures are described below.

2.1.1 Exterior Monitoring and Sampling

Investigation of exterior areas will include a real-time surface soil gamma scan and collection of soil samples that will be submitted for laboratory analysis for radionuclides. The following describes the exterior sampling strategy and procedures:

Real-time Monitoring for Surface Soil Gamma Activity

START will use a sodium iodide (NaI) scintillation detector (e.g., Ludlum Model 44-10 or 44-20), global positioning system (GPS) unit, and data logging software to perform a 100-percent scan of surface soils at selected residential properties. The detector will be held approximately 6 inches above ground surface while the surveyor moves the detector at approximately 1 to 2 feet per second. By referencing the detector readings to their recorded GPS locations, mapping software will be used to display the survey data in real time over aerial imagery. The resulting graphical illustration will be used to evaluate the distribution of gross gamma activity from surface soils throughout the area of investigation, and will help guide selection of locations for soil sampling. Elevated gross gamma activity will be identified on the graphical illustration by distinguishing any individual measurements (using a different plotting color) exceeding the 75^{th} percentile plus 1.5 times the interquartile range (IQR) of the measurements logged at the property (a methodology often used to identify outliers on box-and-whisker plots).

Soil Sampling

The proposed sampling approach is judgmental and described in Table 2. Discrete soil samples will be collected within areas (1) with greatest potential for contamination, including elevated gross gamma activity identified during the surface soil survey (if any); and/or (2) selected on the basis of site features (such as near downspouts).

Composite soil samples will be collected from areas of the yard that exhibit no discrete areas of elevated gross gamma activity (as identified by the surface soil gamma scan). Tetra Tech START will divide these areas of the yard into distinct areas or cells for screening purposes. This number will vary depending on the size and layout of the property. One cell will be in each of the following locations: the front yard, the back yard, and the side yards (if the size of the latter is substantial). The front, back, and side yard composites should be equally spaced within the respective portion of the yard. For residential yards that are greater than 5,000 square feet, the minimum number of cells will be four. There will be two cells in the front yard that will encompass one half of the side yard; likewise for the back yard. Additional areas or cells to be sampled include vegetable gardens and children's play areas. While the maximum size of a cell will be 100 by 100 feet, the actual sizes of cells will be determined in the field based on area features. A cell will extend from the house in all directions 100 feet or to the property line, whichever distance is shorter. A composite sample consisting of five aliquots, each collected from 0 to 2 inch below ground surface (bgs) by use of a disposable stainless steel spoon.

If information obtained during the pre-CERCLIS screening (e.g. information provided by property owners or visual indications of non-native soils) indicates that non-native soils have been placed on the site, a sample will be collected to characterize the suspected non-native soils. For suspected non-native soils that are buried, START will attempt to collect subsurface samples of the soil by use of a hand auger or soil probe. Subsurface samples will be collected from each 6 inch interval to the maximum depth of the non-native soil, or up to 4 feet bgs. Before collecting subsurface soil samples, START will request a utility locate by calling the Missouri One Call System (a minimum of two working days is required to complete the utility locate).

Soil samples will be placed in clean plastic containers or resealable plastic bags. Soil samples will be dried and homogenized by the contracted laboratory.

TABLE 2

ANTICIPATED SAMPLE SUMMARY
EXTERIOR SAMPLING

Location	Sampling Purpose	Number of Samples (per residence)	Sampling Depth	Sample Type	Laboratory Analyses	Evaluation of Results
At discrete areas of elevated gross gamma activity. If no such areas are identified, sample at the discharge points of two downspouts.	Determine the source of elevated gross gamma activity (if identified), and determine radionuclide concentrations for comparison to background.	2 - 5	0 -2 inches	Grab	Isotopic uranium, isotopic thorium, gamma spectroscopy (including radium-226), and lead-210	Compare radionuclide concentrations to soil concentrations determined by the May 2014 sampling performed by EPA during pre-CERCLIS screening at the Bridgeton Municipal Athletic Complex (BMAC) site in Bridgeton, Missouri. In addition, concentrations may be compared to data from previous studies quantifying naturally occurring radionuclides in the United States (see Myrick 1983 and Lowder 1964). Detection of radionuclide concentrations distinguishable from background may indicate CERCLA investigation or response is warranted.
Within areas that exhibit no unusual patterns of gross gamma activity (sampling areas will include the front and back yards, vegetable gardens and children's play areas)	Determine if naturally occurring radionuclides are present over wide areas at concentrations distinguishable from background.	2 – 4	0 -2 inches	Composite		
Non-native soil	Determine radionuclide concentrations for comparison to background.	Up to 8	Up to 4 feet	Grab		

2.1.2 Interior Monitoring and Sampling

The following describes the interior sampling strategy and procedures:

Exposure Rate, Radon, and Surface Activity Characterization Surveys

An initial interior walkthrough of each residence with the home owner will occur to identify living spaces, uses of these, and frequency of occupation. During the walkthrough, a Ludlum Model 19 or 192 microR survey meter will be used to measure exposure rate and to identify presence of gamma sources such as historical consumer products containing radioactive material (e.g., glassware, clocks and watches with radioluminescent painted dials) or building materials with natural radionuclide content (such as stone or brick building materials that may have higher natural radiation levels [Nuclear Regulatory Commission [NRC] 2011]).

Levels of radon (which can be found in homes all over the United States from natural breakdown of uranium in soil, rock, and water) will be measured by use of a Durridge RAD7 real-time radon detector. The detector will be placed in a high-occupancy living space of the home and will collect radon measurements during the interior sampling activities (the detector will run continuously for a minimum of 1 hour). These measurements will inform surveyors of potential presence of radon decay products that can deposit onto surfaces and contribute to surface activity levels. Radon measurements will also be compared to the EPA-recommended action level of 4 picoCuries per liter (pCi/L) (see *A Citizen's Guide to Radon: The guide to Protecting Yourself and Your Family from Radon* [EPA 2016a]).

Measurements of surface activity from various building surface materials will be acquired by use of hand-held detectors to establish baseline activity levels. Surface activity can include contributions from alpha/beta activity of naturally-occurring radioactive materials incorporated into surface materials, deposition of radon daughter products onto surfaces, and contributions from instrument background. Because building materials differ in background activity levels, various surface types (e.g., drywall, tile, carpet, hardwood floors, granite countertops, etc.) will be surveyed. To perform this survey, a Ludlum Model 43-90 zinc sulfide (ZnS) scintillation detector (for alpha activity) and a Ludlum Model 44-9 Geiger Muller detector (for beta and gamma activity) will be used to obtain approximately 10 1-minute static measurements from each predominant surface type identified in the home. Using these measurements, benchmark gross alpha and beta values for each surface will be determined as the 75th percentile plus 1.5 times the IQR of the approximately 10 static measurements recorded for the surface. Static survey measurements exceeding these benchmark values will indicate elevated surface activity. After acquisition of baseline measurements and determination of the benchmark values, scanning and static surveys by use of Ludlum Model 43-90 and 44-9 detectors will occur over numerous surface locations to identify discrete areas of elevated surface activity. These surveys for elevated areas will be judgmental (based on best professional judgment of the sampling team), and will occur in addition to the prescribed dust sampling described below. If a scanning survey identifies a suspect discrete elevated area of surface activity, the location will be flagged, a static one minute count for alpha and beta activity will be performed, the static measurement will be compared to the corresponding benchmark value, and a wipe sample will be collected within that area if a benchmark value is exceeded.

Interior Dust Sampling

Wipe samples will be collected to assess presence of radionuclides in settled dust. The proposed sampling approach is judgmental and described in Table 3. Surfaces to be sampled include floors, walls, and other accessible surfaces; floor surfaces near entrances; and floor and wall surfaces near clothes dryers. On site, a Ludlum 3030 or 3030P drawer counter will count gross alpha and beta activity of each wipe sample. These count results may give the surveyors a preliminary indication of surface activity levels. However, the counts may include contributions from short-lived radon daughter products, and thus the wipes will be counted again after a lapse of at least 24 hours to allow for decay of short-lived radon daughter products. Based on those results, the wipes with higher alpha activity will be selected for laboratory analysis for radionuclides (wipes will be selected as described in Table 3). In addition, bulk dust samples of accumulated dust will be collected by use of micro-vacuum cartridges if areas that contain significant quantities of accumulated dust are found.

TABLE 3

ANTICIPATED SAMPLE SUMMARY
INTERIOR SAMPLING

Room/Location	**Sub Location**	**Sampling Purpose**	**Anticipated Distribution of Radionuclides**	**Selection of Sampling Area**	**Number of Samples (per residence)**	**Sample Type**	**Selection of Samples for Laboratory Analyses**	**Laboratory Analyses**	**Evaluation of Results**
High-occupancy rooms, e.g., bedrooms, kitchen, living room, etc.	Each wall	Assess presence of radionuclides in dust settled on accessible surfaces within living spaces.	Homogenously distributed within settled dust.	Bias to wall area with above-average dust, e.g., near heating, venting, and air conditioning (HVAC) register	16 - 24	Wipe of 100 square centimeter (cm^2) area	Select the three wipes with highest alpha counts -and- Select the wipe with highest alpha count from each high-occupancy room. -and- Select the wipe with highest alpha count from each entrance.	Isotopic uranium, isotopic thorium, and radium-226	Compare to EPA Building Preliminary Remedial Goals (BPRG) (see EPA 2016b) for residential exposure scenarios that correspond to a one in ten thousand (1E-4) cancer risk. Detection of radionuclides above BPRGs may indicate CERCLA investigation or response is warranted. Additional sampling would be required to evaluate risk.
	Floor			Bias to floor area with above-average dust, e.g., near HVAC register or corner of floor	4 – 6	Wipe of 100 cm^2 area			
	Accessible dust-laden surface			Accessible dusty surface, e.g., top of dresser or a shelf	4 – 6	Wipe of 100 cm^2 area			
Less frequently occupied rooms, e.g., bathrooms, closets	Each wall			Bias to wall area with above-average dust, e.g., near HVAC register	40	Wipe of 100 cm^2 area			
	Floor			Bias to floor area with above average dust, e.g., near HVAC register or corner of floor	10	Wipe of 100 cm^2 area			
All entrances	Floor near entrance	Assess presence of radionuclides deposited on floor from foot traffic.	Homogenous if presence of radionuclides is related to settled dust; potentially heterogeneous if presence is related to deposition from foot traffic.	Scan area with a Ludlum 43-90 detector and bias sample to area of relatively higher activity. If detector response is homogenous over the area, select area subject to heavy foot traffic.	2-4	Wipe of 100 cm^2 area			
Laundry room	Wall near dryer	Assess presence and potential contribution of radionuclides to settled dust from washing and drying of clothes.	Homogenously distributed within settled dust.	Bias to wall area with above average dust, e.g., near dryer vent	1	Wipe of 100 cm^2 area			
	Floor			Bias to floor area with above average dust, e.g., near dryer	1	Wipe of 100 cm^2 area			
Area of Accumulated Dust	Area with bulk amounts of accumulated dust (e.g., behind furniture or appliances)	Characterize radionuclides in accumulated dust.	Homogenous if presence of radionuclides is related to settled dust	Scan area with a Ludlum 43-90 detector and bias sample to area of relatively higher activity.	1-2	Vacuum cartridge	Submit each sample for laboratory analysis.	Isotopic uranium, isotopic thorium, and radium-226	Results will only be used to characterize radionuclide concentrations and relative ratios. Results will not be comparable to any health-based standards.

2.2 SAMPLING METHODS REQUIREMENTS

Table 4 references SOPs that will be followed during sample collection.

TABLE 4

SUMMARY OF SAMPLING METHODS

Sample Type	Sample Description	Sampling Method
Soil	Soil collected for laboratory analysis	EPA Region 7 SOP 4231.2012
Wipe	Wipe sample collected for counting in a Ludlum 3030 or 3030P draw counter and/or for laboratory analysis	Field Operating Procedure #1 – Wipe Sampling (see Appendix A)
Bulk dust	Bulk dust collected for laboratory analysis	ASTM D7144 – Standard Practice for Collection of Surface Dust by Micro-vacuum Sampling for Subsequent Metals Determination[1]

Notes:

[1] The radionuclides being investigated (isotopes of uranium, thorium, and radium) are metals.

ASTM ASTM International
EPA U.S. Environmental Protection Agency
SOP Standard Operating Procedure

It is not anticipated that any decontamination of instruments, sampling equipment, or supplies will be required as a part of this investigation. Instruments and sampling equipment utilized for the investigation will be surveyed with instruments that have not been brought inside the home or otherwise come into contact with soil on the property. Should the survey indicate the presence of contamination, the instruments or equipment will be wiped down and a follow up survey will be performed to confirm that the item has been decontaminated.

2.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

Soil, wipe, and bulk dust samples collected for radionuclide analysis will be placed in coolers for secure transport (maintaining samples on ice is not required for radionuclide analyses). Tetra Tech START will complete necessary paperwork for all samples, including COC records, which will accompany the coolers until delivery to the laboratory. COCs will be maintained as directed by Region 7 EPA SOP 2420.04. If shipment of samples is required by commercial service, each cooler lid will be securely taped shut, and two custody seals will be signed, dated, and placed across the lid opening. Samples will be accepted in accordance with procedures established by the START-contracted laboratory. Sample holding times will be specified by the START contracted laboratory (holding times of approximately 6 months are anticipated).

2.4 ANALYTICAL METHODS REQUIREMENTS

Samples will be analyzed by a START-contracted laboratory, according to the analytical methods listed in Table 5. START will verify that the contracted laboratory will be able to achieve the project quantitation goals listed in Table 5. Standard turnaround time for laboratory analyses of all samples will be requested unless otherwise directed by the EPA On-scene Coordinator (OSC).

TABLE 5

ANALYTICAL METHODS

Sample Type	Analyses	Radionuclide(s) of Interest	Project Quantitation Goal (PQG)	Rationale for PQG	Analytical Method
Soil	Isotopic thorium	Thorium-230	1 pCi/g	Background[1]	Alpha spectrometry per laboratory SOP[2]
	Isotopic uranium	Uranium-238	1 pCi/g	Background[1]	Alpha spectrometry per laboratory SOP[2]
	Radionuclides in soil by gamma spectrometry scan	Radium-226	1 pCi/g	Background[1]	Gamma spectroscopy per laboratory SOP[2] preceded by 21-day ingrowth of Radium-226 progeny
	Lead-210	Lead-210	1 pCi/g	Background[1]	Gamma spectroscopy or other analytical method to be determined based on laboratory capability to achieve PQG
Wipe	Isotopic thorium	Thorium-230	2 pCi/wipe	10% of 1E-4 cancer risk BPRG[3]	Alpha spectrometry per laboratory SOP[2]
	Isotopic uranium	Uranium-238	2 pCi/wipe	10% of 1E-4 cancer risk BPRG[3]	Alpha spectrometry per laboratory SOP[2]
	Radium-226	Radium-226	0.5 pCi/wipe	10% of 1E-4 cancer risk BPRG[3]	Analytical method to be determined based on laboratory capability to achieve PQG[2]
Bulk dust (vacuum cartridge)	Isotopic thorium	Thorium-230	1 pCi/g	Background[1]	Alpha spectrometry per laboratory SOP[2]
	Isotopic uranium	Uranium-238	1 pCi/g	Background[1]	Alpha spectrometry per laboratory SOP[2]
	Radium-226	Radium-226	1 pCi/g	Background[1]	Analytical method to be determined based on laboratory capability to achieve PQG[2]

Notes:

[1] PQG is sufficient to detect anticipated background soil concentrations.

[2] Laboratory analyses for radionuclides are typically performed in accordance with reference methods, as documented or amended by the laboratories' internal SOPs.

[3] PQG is sufficient to detect the radionuclide BPRG corresponding to a cancer risk of 1 in 10,000 (1E-4). The BPRGs (corresponding to a 1E-4 cancer risk and a 100 cm^2 basis) are 15.8 pCi/100 cm^2 for Uranium-238, 18.8 pCi/100 cm^2 for Thorium-230, and 0.456E pCi/100 cm^2 for Radium-226. The listed PQGs are approximately 10 percent of these values.

BPRG Building Preliminary Remediation Goal
pCi picoCurie
pCi/g picoCurie per gram
SOP Standard operating procedure

2.5 QUALITY CONTROL REQUIREMENTS

Field sampling and laboratory analysis will accord with their associated SOPs and methods. Field blank samples for wipe and bulk dust sampling will be submitted for the same analyses performed on the primary samples. These field blank samples will be submitted at a rate of 1 per 10 primary samples submitted, or at least 1 field blank per sample type (wipe or vacuum cartridge) per residence sampled.

2.6 INSTRUMENT, EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Tetra Tech START personnel test, inspect, and maintain all sampling equipment and supplies, along with field screening instrumentation provided by EPA, prior to deployment for field activities in accordance with manufacturers' recommendations. Testing, inspection, and maintenance of analytical instrumentation will accord with manufacturers' recommendations.

2.7 INSTRUMENT CALIBRATION AND FREQUENCY

Radiological field instruments will be calibrated with National Institute of Standards and Technology (NIST) traceable sources to radiation emission types and energies that provide detection capabilities appropriate for the isotopes of concern. Instrumentation to be provided by EPA will be calibrated in accordance with manufacturer specifications prior to delivery to the field. Certifications of calibration will be provided. Calibrations are typically performed once per year (or as specified by the manufacturer). Daily response checks (as detailed in Section 2.8) are conducted to assure that the equipment is maintaining calibration. Calibration of laboratory equipment will proceed as described in the previously referenced SOPs and/or manufacturers' recommendations.

2.8 DAILY RESPONSE CHECKS

Radiological field instruments will be response tested prior to daily use. Background and source measurements will be taken as part of the instrument check and compared to the acceptance range for the instrument and site conditions. These response checks will be performed by EPA or START personnel trained in operation of the equipment. These response checks are conducted with sources that emit radiation comparable to the isotopes that the equipment is intended to detect in the field. If response checks indicate the instrument is "drifting" out of calibration, the unit will be removed from service, and a replacement will be obtained. To assure proper instrument function, twice-daily (beginning and end of daily activities) source checks will occur with use of a field check source. The response checks will be documented on a daily response check form (Appendix B).

2.9 INSPECTION AND ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Soil samples collected for radionuclide analysis will be collected into new, food-grade, plastic containers or new Ziploc® or similar bags. Wipe samples will be placed in glassine envelopes.

2.10 DATA ACQUISITION REQUIREMENTS

Previous data and information pertaining to the site (such as other analytical data, reports, photographs, and maps) will not be used for decision making purposes without verification of authenticity and usability.

2.11 DATA MANAGEMENT

All laboratory data acquired will be managed according to procedures established by the START-contracted laboratory.

Data collection will be conducted in the field using customized field sheets to capture sample information. Following laboratory analysis of samples, field collected data and analytical results will be documented using a site-specific Scribe database. Data will be input into Scribe using the built-in Data Import Wizard and/or manually, where it will be summarized and made available for reporting and mapping. Customized queries will be developed in Scribe to facilitate report generation for EPA and property owners.

3.0 ASSESSMENT AND OVERSIGHT

The following sections address aspects of assessment, oversight, and reporting.

3.1 ASSESSMENTS AND RESPONSE ACTIONS

Assessment and response actions pertaining to analytical phases of the project will be conducted in accordance with procedures established by the START contracted laboratory. Any issues related to QA will immediately be reported to the EPA On-Scene Coordinator. Corrective action will be taken at the discretion of the EPA On-Scene Coordinator whenever problems appear that could adversely affect data quality or resulting decisions affecting future response actions pertaining to the site. Due to the short timeframe (less than a week) during which the screening will be completed, no field audits will be conducted.

3.2 REPORTS TO MANAGEMENT

Following receipt of laboratory analytical data START will submit a report to the EPA On-Scene Coordinator documenting Pre-CERCLIS screening activities (including real-time survey results, on-site measurements, and sampling methods with laboratory analytical results). The report will also include interpretation of analytical results and validation of any data generated by START contracted laboratories.

4.0 DATA VALIDATION AND USABILITY

The following sections address aspects of data review, validation, verification, and usability.

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Laboratory analysis by the START-contracted laboratory will accord with guidance in the Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP) (EPA 2004). START will request fully documented (Level IV) data packages from the laboratory. The data packages will be validated internally by the laboratory in accordance with MARLAP and the laboratory's established SOPs.

A START chemist will conduct an external verification and validation of the laboratory data package in accordance with MARLAP. Findings of the external verification and validation will be documented in a data validation report that will be included in the final pre-CERCLIS screening report. The data validation report will provide an evaluation of the blank results (including field blanks and laboratory method blanks) and include an assessment for suspected contamination of the blanks. Suspected contamination will be noted in the data validation report and the report will describe any suspected effects on the sample results. The acceptance and rejection criteria applied to the results will be in accordance with MARLAP and the laboratory's established SOPs.

4.2 VALIDATION AND VERIFICATION METHODS

The data will be validated by application of methods consistent with validation procedures described in MARLAP (EPA 2004). The EPA On-Scene Coordinator will be responsible for overall validation and final approval of the data, in accordance with projected use of the results.

4.3 RECONCILIATION WITH USER REQUIREMENTS

If data quality indicators do not meet the project's requirements as outlined in this QAPP, the data may be discarded, and re-sampling or re-analysis may be required. No additional statistical analyses will be applied to the analytical data.

5.0 REFERENCES

Lowder, W. M., Condon, W. J. and Beck, H.L. (Lowder *et al.)* 1964. "Field Spectrometric Investigations of Environmental Radiation in the U.S.A," page 597.

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Tetra Tech, Inc. (Tetra Tech). 2014. Final Pre-CERCLIS Screening Report, Bridgeton Municipal Athletic Complex, Bridgeton, Missouri. July 17.

U.S. Environmental Protection Agency (EPA). 2004. Multi-Agency Radiological Laboratory Analytical Protocols Manual (MARLAP). USEPA 402-B-04-001A. July.

EPA. 2016a. A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon. December. https://www.epa.gov/radon/citizens-guide-radon-guide-protecting-yourself-and-your-family-radon

EPA. 2016b. Preliminary Remedial Goals for Radionuclides in Buildings (BPRG). Accessed December 19. https://epa-bprg.ornl.gov/

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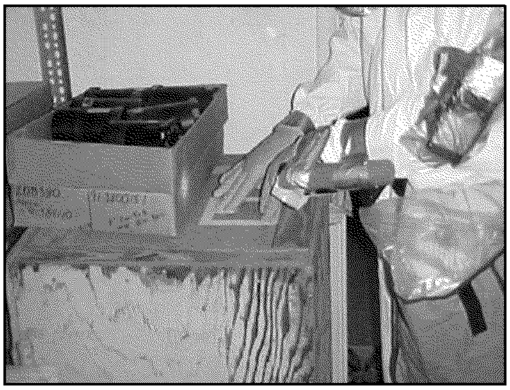
APPENDIX A

STANDARD OPERATING PROCEDURES

Field Operating Procedure #1
Wipe Sampling



Step No.	WIPE COLLECTION
1	Use 47-millimeter (mm) diameter Whatman filter paper (Part No. FP2063-47) or similar, typically called a "wipe," for collection of surface contamination.
2	Number each wipe on the back of the filter prior to sample collection. The back of the filter is typically smoother than the front.
3	With moderate pressure, press the wipe onto the surface and move the wipe in an "S" pattern to cover a 10- x 10-centimeter (cm) area (or an area representing 100 cm^2) of the survey location. Use caution when collecting a wipe sample from rough surfaces (concrete, brick, etc.) that may tear the wipe. Use a 100-cm^2 template cutout as a guide, if available (see photograph above); do not reuse templates.
4	Place the wipe in a glassine envelope (RSO, Inc., Stock No. AC-G3218), or similar envelope to protect the sample.
5	Record required sample information such as sample number, location, date, and time in the field logbook or designated field form.

APPENDIX B

DAILY RESPONSE CHECK FORM

Ratemeter Daily Response Check

Ratemeter:
SN:
Detector:
Detector SN:
Check Source:
Check Source SN:
Calibration Due:

Project:
Location:
Operator:

Date	Time	Battery (volts)	HV Setting (volts)	Threshold	Window Value	Window Setting (in/out)	Response (fast/slow)	One Minute Background Reading	One Minute Source Reading	Approval	Comments